EFFECT OF BALANCE RETRAINING STRATEGY IN IMPROVING POSTURAL STABILITY AND GAIT SPEED AMONG IDIOPATHIC PARKINSON PATIENTS

-AN EXPERIMENTAL STUDY

Dissertation submitted to The Tamil Nadu Dr. M.G.R. Medical University towards partial fulfilment of the requirements of **MASTER OF PHYSIOTHERAPY (Advanced PT in Neurology)** Degree programme.

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CERTIFICATE

This is to certify that the research work entitled **"EFFECT OF BALANCE RETRAINING STRATEGY IN IMPROVING POSTURAL STABILITY AND GAIT SPEED AMONG IDIOPATHIC PARKINSON PATIENTS"- An experimental study",** was carried out by **Register No.27091607,** KMCH College of Physiotherapy, towards partial fulfilment of the requirements of The Master of Physiotherapy (MPT) degree course under The Tamilnadu Dr. M.G.R. Medical University, Chennai – 32.

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CONTENTS

ABSTRACT

OBJECTIVES

'The objectives of this study were to find the Effect of Balance Retraining Strategy in improving Postural Stability and Gait Speed among patients with Idiopathic Parkinsons disease on stage II and III.

STUDY DESIGN: Pre-test, post-test experimental study design. **PARTICIPANTS:** Eight subjects of age between 55-75yrs with Idiopathic Parkinson disease were included in this study. **INTERVENTION**: Subject pre-test assessment have been taken in the first day of treatment and all the participants treated with balance recovering strategy training for one hour per session, 3 sessions per week for the study duration of about 4 weeks. The post-test assessment was taken at the end of fourth week. **OUTCOME MEASURES**: Postural instability was assessed with Nutt Unexpected Retropulsive Test. Balance and Gait was assessed with Tinetti Mobility Scale. Gait speed was assessed with 10 Meter Walk Test. **RESULTS:** After 4 weeks of treatment patient showed significant improvement in postural stability, balance and gait.

CONCLUSION: Balance Retraining Strategy training is an effective treatment intervention for improving postural stability, balance and gait among idiopathic Parkinson patient.

KEY WORDS:

Balance Retraining Training, Postural Instability, Anticipatory Training.

1. INTRODUCTION

Idiopathic Parkinson disease is a progressive neurological disorder whose prevalence increases with advancing age. Epidemiological estimation suggest that idiopathic Parkinson's disease currently affects between 4.1 and 4.6 million individuals older than the age of 50years in the world's 10 most popular nations.

Idiopathic Parkinson can be defined pathologically by the loss of dopamenergic neurons in the pars compacta of the substantia nigra[41]. Idiopathic Parkinson disease is manifested by neurological symptoms like difficulty in initiating movements, slowness and difficulty in maintaining movements and reduced ability to switch between different coordination patterns, stiffness in the arm, legs and trunk Postural instability and tremor at a frequency of 5-6Hz, gait instability and cognitive impairments are the other main symptoms of idiopathic Parkinson disease.

Postural problems were common in idiopathic Parkinson patients. They were characterized as an impairment to sustain the upright position and therefore affect gross motor skills and mobility skills. Up to 96% of all idiopathic Parkinson disease patients experience a decline of postural reactions during the course of the

disease (E. Michael Jo¨ bges). 38 of 100 patients with idiopathic Parkinson disease patients encountered falls, 13% of them had falls more than once in a week[31.]

Reasons for Postural instability in people with Parkinson disease are multifactorial and is related to disease severity, lower extremity co-contractions causing reduced adaptability to postural changes and reduced magnitude of agonistic muscle activation patterns in the lower extremities produces an under scaled stepping strategy. As the disease progress, the postural instability is classically seen in backward direction. And there will be impairments in anticipatory postural adjustments, results in reduced trunk – righting ability and lower extremity response to the postural changes. It also results in greater difficulty in maintaining the centre of mass over the base of support for maintaining the balance.

Gait is an extremely compound function that requires integration of mechanisms of locomotion with those of motor control, musculoskeletal function, balance and posture. The mobility problems related to gait disturbances, postural instability along with repeated falls have a reflective negative impact on patient's quality of life and their mental health[78.]

Idiopathic Parkinson affects multiple structures of the CNS and exhibit a broad variety of clinical symptoms that are only partially treated by pharmacological treatment. Therefore non-pharmacological approaches are highly necessary for the rehabilitation of idiopathic Parkinsonian patients.

Physical Therapy may serve as an important adjunct to the available pharmacological and neuro-surgical treatment regimes. Postural responses differ on the effect of L-dopa medication alone or in combination with other anti Parkinson's medication. Muscle activation while on state L-dopa can improve the magnitude and relative timing of postural muscles all though not to the level of normal values. Off state there is increase in severity of symptoms and reduced mobility.

Evaluating the postural stability, balance and gait in people with Parkinson disease requires creating a loss of balance in posterior direction and observing recovery capability. Nutt Unexpected Retropulsive Test is commonly used assessment tool to evaluate the postural instability.

Balance and gait components of the Parkinson patients are commonly assessed with Berg Balance Scale, Tinetti performance oriented mobility scale and Ten Meter Walk Test.

Physical exercise demonstrated a reduction in mortality rate in individual with idiopathic Parkinson patients. Physical exercises can improve the motor performance, cognitive level and functional abilities. Exercise can stimulate the synthesis of dopamine via increased serum calcium level (Akiyama 2003).

So it is necessary to formulate an exercise programme which the patients can practice in daily activities and by break down complex motor sequence in balance and gait in to smaller individual components will help to improve the postural stability, balance and gait in idiopathic Parkinson patients.

1.1 NEED FOR THE STUDY

Postural instability is one of the disabling features of idiopathic Parkinson's disease (IPD).There is moderate evidence that exercise resulted in improvement of postural instability and balance task performance[4.] The optimum dosage of exercise, the content of exercise intervention and the component of exercise at different stages of the disease are also not clear in previous studies.

In idiopathic Parkinson patients during postural changes there is an activation imbalance between the agonist and the antagonist muscle and it results in loss of balance. They shows significantly reduced ankle feedback gain compared to a normal individual of the same age group, with a slow scaling ,a larger hip feedback gain and this results in reduced postural response during the postural challenges. So the intention of my study is to formulate an effective balance retraining therapeutic exercise programme which improves the balanced muscle activation pattern between agonist and antagonist during postural changes, narrow and wide base of support so that the adaptability of the muscle will be good during the postural changes. And it will help to improve the postural stability, balance and gait among idiopathic Parkinson patients.

2. REVIEW OF LITERATURE

2.1 IDIOPATHIC PARKINSON DISEASE:

Idiopathic Parkinson disease is progressive neurological disorders whose prevalence increases with advancing age. And it affects multiple structures of the CNS and shows variety of clinical symptoms that are only partially treated by pharmacological treatment. Thus, non-pharmacological approaches are very much essential for the rehabilitation of idiopathic Parkinson disease patients.

- **Queen Elizabeth Hospital, Hong Kong, (March 2010)** Parkinson's disease is an incurable disease. Treatment includes pharmacologic intervention and non-pharmacological intervention such as physiotherapy. Exercise to strengthen the muscles and to improve balance and walking, and use of visual cue training are found to be effective in patients with idiopathic Parkinson disease.

- **International federation of clinical neurophysiology (2008)** the motor signs of Parkinson disease are thought to be as a result of reduction in levels of dopamine in basal ganglia. There is degeneration of dopamine neurons in midbrain resulting in development of Parkinson disease. The main Electrophysiological changes seen in idiopathic Parkinson patients are the altered discharge rate, increased burst firing rate and, altered sensory motor processing, in basal ganglia ,thalamus and cortex. This results in alteration in planning and execution of movement[48.]

2.2 POSTURAL INSTABILITY

Postural instability is characterized as an impairment to maintain the upright position .which affect the gross motor and general mobility skills. 96% of the idiopathic Parkinson patients experience decline of the postural reaction during the course of the disease.

- **J. D. Holmes et al., (2010)** Postural instability is a frequent and incapacitating symptom of Parkinson's disease (PD) and is poorly responsive to pharmacotherapy. As a result, patients must use the

attentional strategies by mentally Rehearsing action sequences repeatedly or consciously giving attention to their balance components and also to maintain the equilibrium within the base of support.

- **Marilym Trail,Elizabeth.j.Protas, et al.,(2005)Neuro rehabilitation of idiopathic Parkinson.)** Postural instability in idiopathic Parkinson is multifactorial and is related to disease severity[68.]

- **J.W. Błaszczyk et al., (2007),** Postural instability is one of the disabling features of idiopathic Parkinson's disease (PD). This study focused on postural instability as the main factor predisposing for falls in idiopathic Parkinson patients[50.]

- **R. Orawiec et al., (2007),** Postural sway in idiopathic Parkinson patients significantly correlated with disease severity rated both by the Hoehn and Yahr scale as well as by the Motor Section of the UPDRS. A forward displacement of the mean centre of pressure is greater in idiopathic Parkinson patients, which result in their flexed posture and it is significantly greater when compare with the elderly subjects of the same age group[95.]

- **Dimitrova et al., (2004),** People with Parkinson disease demonstrated a loss of trunk flexibility and trunk righting capabilities, and can have difficulty in maintaining the position of the centre of mass over the base of support. Secondarily greater dependence on stepping strategies will be necessary to establish a new base of support. Faster and larger stepping response will be necessary to maintain stability. It will be delayed in Parkinsonism patients and loss of stability in a narrow base of support is common in later stages of the Parkinson disease[25.]

- **Tjitske A et al.,** have concluded that difficulty in turning may be caused by axial rigidity, reduced inter-limb co-ordination and asymmetrical movements of the limbs resulting in turning difficulties. Turning difficulties are easily assessed with timed performance and the number of steps during a turn. Impaired sensorimotor integration, inability to switch between sensory modalities and lack of compensatory stepping may all contribute to the high incidence of fall rate in patients with idiopathic Parkinson's disease.

- **Ferrini et al., (2007) -** Postural instability and gait disturbed (PIGD), elderly people are more prone to have disturbed gait and unstable posture.

Some studies have suggested that if these symptoms appear early, they predict a faster decline in gait and posture with tremor predominant. Gait disturbance is a particularly serious sign in the elderly; it increases the risk for falls and injury[35.]

- **Gracovetsky et al.,** Posture is maintained by proper alignment and maintenance of body segments in certain positions, such as standing, lying, or sitting. There is an optimal posture for any given task, Considerable deviations from optimal posture are thought to be aesthetically unpleasant, adversely influence muscle efficiency, and predispose individuals to musculoskeletal or neurological conditions.

- **Berardelli.A.et al.,** Parkinson disease patients have difficulty initiating movement and are globally slow in executing motor commands. Such abnormalities result from reduced motor excitability and insufficient activation of the cortical areas, supplementary motor area, and primary motor cortex, which involved in planning and executing motor activities.

- **E. Michael Jo¨ bges et al., (2007),** Postural problems are common in Idiopathic Parkinson's patients. They are characterized by an impairment to maintain the upright position and therefore affect gross motor skills. Up to 96% of all Idiopathic Parkinson's patients experience a decline of postural reactions during the course of the disease[31.]

- **Koller et al., (2009)** reported that 38 of 100 patients with Idiopathic Parkinson's disease encounter falls, 13% of them more than once a week, 13% experience fractures, 18% require hospitalization, and 3% are confined to a wheelchair[59.]

- **Roberts-Warrior D et al., (2000)** found that Levodopa increases body sway more in the medio-lateral than in the anterior posterior direction, postural instability is worsened in the patient with dopamine intake[29.]

- **Mitchell et al., (2008)** he hypothesized that medio-lateral sway is an important posturographic marker of functional balance impairment in Parkinson disease[73.]

- **Behrman .A .L et al., (2010)** revealed that balance deficits and gait impairments as a potential fall risk factors for patients with Parkinson disease[15].

- **Adkins. A. L et al., (2003)** stated that lower balance confidence level in people with Parkinson disease was related to poorer postural stability, as reflected by increased postural sway in the standing position[2].

- **S.H.J Keus et al., (2007)** stated that most patients with Parkinson disease face mounting mobility deficits, including difficulties with transfers, posture, balance,and walking[98].

- **M.J. Nijkrake.et al., (2010)** Postural instability is a problem for many PD patients and can lead to falls. Most falls are "intrinsic" caused by patient-related factors, e.g. freezing during turning, but extrinsic factors like narrow doorways or slippery floors may also play a major role. Exercises to improve balance and to prevent falls were found to be effective[77].

- **Pai et al, (2003)**, standing postural stability is typically described as the ability to control the body centre of mass over its base of support. Loss of balance occurs when there is a change in the position of centre of mass and the line of gravity when it fall outside the limit of base of support and a new base of support is necessary to maintain the balance. The postural adjustment and stepping strategy needed to keep the line of gravity within the base of support is delayed in idiopathic Parkinson patients.

2.3. BALANCE AND GAIT DISTURBANCES

- **Carlsson et al., (2003)** Parkinson disease is a neuro degenerative disease characterised by tremor, rigidity ,bradykinesia, and postural instability. The classical symptom of the Parkinson is impaired balance and gait and its leads to postural instability[67.]

- **Stewart. A, et al., (2002)** in idiopathic Parkinson disease patients gait initiation will be delayed and the movement preparation, execution time will be prolonged during the gait initiation. There will be a co-contraction of both the group of muscles in the lower limb. The typical gait pattern will be slow gait with reduced stride length, cadence, and

increase time spent on the double limb support of the stance phase of the gait cycle[99].

- **Silvi Frenkel-Toledo et al., (2005)** concluded that the ability to maintain a steady gait rhythm is impaired in patients with Parkinson's disease, and impaired automaticity in PD, can be quantified by measuring the stride-to-stride variability of gait timing. Patients with PD also generally walk with reduced gait speed variability. The increase in stride variability and impairment in the rhythm of gait in PD may reflect as reduced automaticity and damaged locomotor synergies[100].

- **Jobges et al., (2004),** proposed a method of repetitive training of compensatory steps to enhance protective postural responses by using training strategies based on recent neurophysiological research. After 2 weeks of training the length of compensatory steps increased and the step initiation started earlier[65].

- **T. Herman et al., (2008)** Gait disturbances are an integral part of the clinical manifestation of PD and among the most disabling symptoms of the disease. The gait of patients with PD is typically marked by

reduced speed, shortened stride length, and longer double support time[107.]

- **M. Rossi et al., (2009),** they states that Parkinson disease subject showed significantly smaller than normal ankle feedback gain, which led to an early violation of the flat-foot constraints and unusually small postural responses[81.]

- **M. Rossi et al., (2009),** they found that abnormal feedback gain and reduced ability to modify postural feedback gain with changes in postural challenge seen in Parkinson disease[81.]

- **Dimitrova and colleagues et al., (2004),** they compared the postural response of people with idiopathic Parkinson disease on their off mode with the age matched control group. Among the two groups the Muscle activation synergies were found to be similar between two groups but the magnitude of the activation of the agonist muscle with those with the Parkinson disease was below those of the control[24.]

- **Band J, Morris et al., (2000)** in his previous experiments in gait speed showed that people with moderately disabling idiopathic Parkinson patients walk slowly, with short steps and relatively normal cadence when asked to walk freely at a comfortable pace[72.]

- **N. Chastan et al., (2009),** patients with parkinsons disease who were not treated showed reduced step length and velocity and poor braking just prior to foot-contact, with a decrease in both soleus and anterior tibialis muscle activity[86.]

- **Horack et al., (2005),** In Parkinson patients the pattern of muscle activity used is ineffective in maintaining the balance and Inability to change movement strategies quickly to adapt to the change in the supporting surface is characteristic of people with idiopathic Parkinson disease[46.]

- **Keijsers et al., (2005),** Idiopathic Parkinson patients tend to lack accurately scaled movements because of inability to integrate the proprioceptive inputs centrally. So must heavily rely on visual input to optimize movements, this reliance increases with disease severity[60.]

2.4. UNIFIED PARKINSON DISEASE RATING SCALE

- **Teva Neuroscience, (2006),** the Unified disease rating scale is designed to assess PD symptoms and this scale has the 20 years of broad usage history. UPDRS is the most commonly used research tool to evaluate new treatments for Parkinson's disease .It Includes both scoring by a clinician (motor examination) and the report of mental functioning and activities of daily living (ADL) obtained by questioning the patient by the examiner. And allow the examiner to assess the worsening or improvement of Parkinson disease symptoms and signs over time Symptomatic worsening or there

  Improvement can be measured as a change from baseline score.

  — Deterioration of symptoms increases score.

  — Improvement in symptoms decreases score

Total UPDRS consists of four parts2 and the Parts I, II, and III contain 44 questions each measured on a 5-point scale (0-4).

I. **Mentation, behavior, and mood:** intellectual impairment, thought disorder, motivation/initiative, and depression.

II. Activities of daily living (ADL): The components include speech, salivation, swallowing, handwriting, cutting food, dressing, hygiene, turning in bed, falling, freezing, walking, tremor, and sensory complaints.

III. Motor examination: Such as speech, facial expression, tremor at rest, action tremor, rigidity, finger taps, hand movements, hand pronation and supination, leg agility, arising from chair, posture, gait, postural stability, body bradykinesia.

In monotherapy, a "Total score for UPDRS" is the combined sum of parts I, II, and III: 0 (not affected) to 176 (most severely affected). In adjunct therapy, part IV is included. Part IV contains of 11 questions and the scale can range from 0 to 23[61.]

IV. Complications of therapy: dyskinesia-duration, dyskinesia-disability, dyskinesia-pain, early morning dystonia, "offs"-predictable, "offs unpredictable, "offs"-sudden, "offs"-duration, anorexia-nausea-vomiting, sleep disturbance, symptomatic orthostasis.

2.5. HOEHN AND YAHR SCALE

The Hoehn and yahr scale .The Hoehn and Yahr scale is the most widely used system for describing how the symptoms of Parkinson's disease progress.

It was originally published in 1967 in the journal Neurology by Melvin Yahr and Margaret Hoehn. The original scale included stages 1 through 5. Since then, stage 0 has been added, and stages 1.5 and 2.5 have been proposed.

2.6. BALANCE RETRAINING STRATEGY TRAINING

- **Giovanni Abbruzzese.et al., (2008),** Hence there is a solid rationale for motor rehabilitation in PD with the aim of improving quality of life. The main goals of rehabilitation is to prevent or cutting down secondary complications due to reduced mobility, optimizing the residual functional capacities, and compensating for the defective abilities by means of new strategies or environmental changes[41.]

- **Judge et al., (2003),** conducted a study in older adults in order to improve the balance and they had undergone 45 minutes of balance training 3 times a week for 8 weeks duration. Session included single leg stance and tandem stance walking on the form. The examiner found that there was a significant improvement in single leg stance, functional base of support.

Sensory organization test of balance and function also showed significant improvement[49].

- **Province et al., (1995),** concluded that some form of balance retraining exercise appear to be most effective type of exercise for Improving the balance of the individuals with idiopathic Parkinson disease[71].

- **G. Kwakkel et al., (2007),** Physical Therapy (PT) may serve as an important adjunct to the available pharmacological and neurosurgical treatment regimes, pharmacological treatment is often insufficient to improve non-dopaminergic symptoms such as lack of balance control and resulting falls. Therefore, regular physical exercise therapy sessions, supported by a physical therapist, are warranted for most patients with Idiopathic Parkinson disease[43].

- **Elizabeth J. Protas et al., (2005),** concluded that Gait and step perturbation training resulted in a reduction of falls and improvements in gait and dynamic balance. This is a more useful approach to reduce falls for patients with PD.[34].

- **Keus S H et al., (2007),** there is an increasing evidence to suggest that physiotherapy can improve mobility deficits in patients with Parkinson's disease (PD), including difficulties with transfers (e.g. rising from a chair), balance or gait[55.]

- **M.J. Nijkrake et al., (2010),** Postural instability is a problem for many PD patients and can lead to falls. Most falls are "intrinsic" (caused by patient-related factors, e.g. freezing during turning), but extrinsic factors (e.g. narrow doorways or slippery floors) also play a role. Exercises to improve balance and to prevent falls were found to be effective[77.]

- **Jahanshahi . M, et al., (1995),** there is considerable evidence that patients with PD have greater difficulty with self-initiated movements than with externally triggered movements. The physiological approach to rehabilitation in PD is aimed at changing the skilled and automatic motor activities into new movement strategies that are not routinely processed through the faulty basal ganglia system. Additional impairment during sequential movements (''sequence effect'') break down complex motor sequences into smaller individual components[70.]

- **Goede et al., (2007),** conducted a systematic review which support the hypothesis that patients with Parkinson disease may benefit from exercise therapy in terms of activities of daily living and walking ability (walking speed, stride length).[35]

- **Keith Dhill et al., (2008),** conducted a study on effectiveness of balance training exercise in people with mild to moderate severity Alzhemer disease, in his study he suggested that balance training shows significant improvement in dynamic components of balance[54.]

- **Dibble Le et al., (2009)** states that there is reasonable evidence that exercise resulted in improvement in postural stability. The activity category has a moderate evidence that exercise was effective for improving balance task performance[26.]

- **Barbara.a,Lice, et al., (2008)** conducted a study on perturbation based balance training for older adults .people selected for this study were between the age group of 64 and 80, study duration of about

8weeks, 30min training session, following the training session participants showed significant improvement in balance[69.]

2.7. TINETTI MOBILITY SCALE

- **Tinetti et al., (1988)** Four items which relate to balance (unsteady sitting down, unable to stand in single stance, Unsteady turning, unsteady when nudged) and three items related to gait (increased Trunk sway, increased path deviation, speed, in combination) predicted falls and Tinetti scores (Whitney et al., 1998) are correlated with Berg Balance scale (r=0.91), With stride length (r=0.62-0.68), and with SLS (r=0.59-0.64)[106.]

- **Bloem et al., (2004)** Tinetti performance oriented mobility assessment (t-POMA) is a reliable and valid tool for assessing the balance and gait status and fall risk of individuals in early to middle stages of the parkinsons disease.(Hoehn&Yahr stages 1-3)[13.]

- **Robbins et al., (2003)** study of predictors of falls among elderly people he found that T-POMA scale is a reliable and valid clinical test to measure balance and gait in elderly people and some patient population[92.]

- **Dibble L E Lange. M et al., (2006)** conducted a study on predictors of fall in individual with Parkinson disease a reconsideration of clinical balance measures. He recommended T-POMA scale is more reliable and valid to measure balance and gait as well as the fall risk in Parkinson patient[28.]

- **Deb K Kegelmeyer et al., (2007)** he examines the interrater and inrarater reliability, concurrent validity and criterion validity on the T – POMA scale as a fall risk screening tool by assessing the balance and gait in individual with Parkinson disease[23.]

2.8. NUTT UNEXPECTED RETROPULSIVE TEST

- **Martine Visser et al., (2003)** the most valid test for postural stability in idiopathic Parkinson disease was an unexpected shoulder pull, executed once, with taking more than 2 steps backward considered abnormal.

The retropulsion test is highly efficient in a clinical setting and it is highly reliable in assessing idiopathic Parkinson patients[82]

- **Martinez-Martin p, et al., (1994)** there was a high interrater reliability for most ratings, with weighted κ ranging from .63 for the UPDRS to .98 for both the Pastor rating and steady-stance positions. Most ratings distinguished between the groups. However, the highest overall predictive accuracy was for the Nutt rating scale, with a sensitivity of 0.63 and a specificity of 0.88[78.]

2.9. 10 METER WALK TEST

- **Van Hedel et al., (2005)** Assesses short duration walking speed (m/sec) using 10 meter walk test, it has been used in various patient populations including stroke, Parkinson's disease, general neurologic movement disorders and spinal cord injured patients[109.]

- **Rachael Lowe. A, et al.,** randomized controlled trial of movement strategies compared with exercise for people with parkinson's disease .Movement Disorders, oct, 2008.

- **Kevin J Brusse, et al., (2005)** concluded that gait speed may be used to quantify some aspects of functional performance, which is not assessed by the UPDRS[62.]

2.10. DURATION OF THE TREATMENT

- **Georg Ebersbach et al., (2008),** Whole body vibration applied 5 times a week for 3 weeks was not more effective for improvement of equilibrium and gait in PD than conventional PT when applied as part of a comprehensive inpatient rehabilitation program[42.]

- **Takayo Chuma et al., (2007)** Exercise can improve primary and secondary symptoms and can be beneficial for patients in all stages of PD. Aerobic exercise, stretching exercises and strengthening exercises should be included in the exercise program. Twenty minutes of exercise three times a week is best[105.]

3. AIM AND OBJECTIVES

3.1 AIM

The main aim of this study is to find the Effect of Balance Retraining Strategy in improving Postural Stability and Gait Speed among stage II and III Idiopathic Parkinson patients.

3.2 OBJECTIVES

- To study the effect of balance retraining strategy on postural instability in idiopathic Parkinson patients.
- To study the effect of balance retraining strategy on balance and gait speed in idiopathic Parkinson patients.

4. MATERIALS AND METHODOLOGY

4.1. STUDY DESIGN

- Pre-test, post-test single group experimental study.

4.2. STUDY POPULATION

- Patients with idiopathic Parkinson stage II and III were selected for the study.

4.3. STUDY SETTING

- Department of physical medicine and rehabilitation-KMCH, Coimbatore.
- Home setting.

4.4. SAMPLE SIZE

- Eight subjects

4.5. SAMPLING TECHNIQUE

- Purposive sampling technique.

4.6. CRITERIA FOR SELECTION OF PATIENTS

4.6.1 INCLUSION CRITERIA

- Subjects with age groups of 50 – 75 years.
- Both genders are included.
- Subject who are in stage 2-3 in modified Hoenn and Yahr Parkinson scale.
- Able to walk 12 meters at least three times without assistive device.
- Patients have mini-mental state examination score is ≥24.
- Medical evaluation of the subjects reported no neurological or orthopaedic disorders that could affect the posturographic testing.
- Patients who provide informed consent.

4.6.2 EXCLUSION CRITERIA

- Any postural impairment due to old age other than Parkinson disease.
- Severe co-morbidity influencing mobility or life threatening disease.
- Not motivated to participate in physiotherapy.

- Postural hypotension or vestibular disturbances or visual disturbances are excluded.
- Visual and vestibular disorders affecting balance.
- Subject with the history of frequent fall.
- History of osteoporosis, fracture and ankle instability

4.7 HYPOTHESIS

4.7.1 NULL HYPOTHESIS

H_{o1}-There is no significant improvement in postural stability on Nutt Unexpected Retropulsive test with balance retraining strategy.

H_{o2}-There is no significant improvement in balance and gait on Tinetti performance oriented mobility scale with balance retraining strategy.

H_{o3}- There is no significant improvement in gait speed on 10 meter walk test with balance retraining strategy.

4.7.2 ALTERNATIVE HYPOTHESIS

H_{a1} - There is significant improvement in postural stability on Nutt Unexpected Retropulsive with balance retraining strategy.

H_{a2}- There is significant improvement in balance and gait on Tinetti Performance Oriented Mobility Scale with balance retraining strategy.

H_{a3}- There is significant improvement in Gait Speed on 10 Meter Walk Test with balance retraining strategy.

4.8. PROCEDURE

Participants with idiopathic Parkinson's disease were evaluated on Unified Parkinson Disease Rating Scale, and the Participants were tested during their self-determined peak, or "ON", phase of their medication cycle and ensuring that all individuals took their usual medications approximately two hours before testing. All the participants signed the informed consent. Eight participants (7 men and 1 woman) with a clinical diagnosis of idiopathic Parkinson's disease were recruited voluntarily. Participants were between the ages of 55 to 80, and there were no significant age differences between the subjects.

Participants were not taken into the study if they were experiencing any Neurological disorders other than PD. Additionally; individuals with a Modified Hoehn and Yahr in stage 1, 4, 5 were excluded from the study.

PRE-TEST ASSESSMENT

Before training postural instability, balance and gait speed of the Parkinson patients are assessed using Nutt Unexpected Retropulsive Test, Tinetti Performance Oriented Mobility Scale, and 10 Meter Walking Test respectively.

POST- TEST ASSESSMENT

Post-test assessment is taken 4 weeks after the treatment section. This clinical information of subjects is presented in appendix III, along with relevant demographic information.

INTERVENTION

EXPERIMENTAL GROUP

Before the training session, warm up exercise are given to the patients for 5 min. This includes simple active movements of both upper and lower limbs which include,

- Hip flexion and extension
- Knee flexion and extension

- Ankle dorsiflexion and plantar flexion

Rest period between each exercise is 2 min, and the total treatment duration is 1 hour and treatment session is 3 times per week

Combined Lateral and Forward Leg Lift

Stand with your shoulder width apart, toes facing forward, knees slightly bent, you may hold on a steady chair for support if needed. Slowly lift one leg out to the side keeping your back straight and your toes facing forward hold for 5 seconds .6 to 8 inches is a good goal.

And slowly lower your leg in a controlled manner. Lift the same leg forward in a same manner and hold it for 5 seconds alternatively do the lateral leg lift and forward leg lift on same leg and then switch to the other leg. After this exercise 2 min rest is given.

Repetition: 10 times per leg

Figure: 1 Combined Lateral and Forward Leg lifting

Stepping Exercise

Stand with your shoulder width apart, with a 15 cm high step positioned 5 cm in front of foot. Subject has to step on and off their foot 20 times. Make sure that all your plantar aspect of the foot comes in contact with the step. Alternatively do this exercise in both the legs.

Repetition: 10 times per leg.

Forward Toe Touch/Arm Reach

Stand with your shoulder width apart. Raise your hands up to your shoulders with your palms facing forward. From this extend your right upper limb and place your left leg forward, pointing down with your toes and toes touching the floor. Return to the starting position.

Extend your left arm and place your right foot forward, pointing down with your toes and toes touching the floor. Returns to the starting position. Alternatively do this exercise on both the sides.

Repetitions: 10 times per leg.

Sit-to-Stand Practice

- Rocking back and forth in a chair as a preparation for standing up (arms crossed)
- Standing up from a chair with support from the arms of the chair and from the therapist.
- Stand up from a chair with arms crossed and support from the therapist when necessary.
- Sitting down on a chair by controlling the descent (eccentric quadriceps femoris muscle contraction)

Wall Supported Mini Squatting

Stand with your shoulder width apart and close to a wall and subject has to go for mini squatting in standing with wall supported and maintain in that position for 15 seconds and come to the starting position.

Repetitions: 10 times.

Figure: 2-Wall Supported Mini Squatting

Forward in Place Response Training

Subject position

Stand with your shoulder width apart, arms at your sides.

Subject's instruction

I am going to push against you to train your balance reaction .Do not allow my hands to push you backwards .when i let go keep your balance without taking a step.

Trainer Position

Stand in front of the patient, place one hand on each shoulder and lightly push the patients backward until there anterior muscles contract and toes just start to extend then suddenly release, don't allow any leaning by the patients.

Repetition: 10 times.

Backward in Place Response Training

Subject Position

Stand with your shoulder width apart, arms at your sides

Subject's Instruction

I am going to push against you to train your balance reaction .Do not allow my hands to push you forward .when i let go keep your balance without taking a step.

Trainer Position

Trainer stands behind the patient, places one hand on each scapula and isometricaly hold against the patients back push, until the heels are about to be lifted and at same time do not allow the trunk to move then suddenly release the push. Don't allow any leaning by the patient.

Repetitions: 10 times.

Lateral Stepping Training

Subject Position and Procedure

Stand with your shoulder width apart, arms at your sides. Lean on to my hand beyond your side way limits .when i let go step if you need to avoid the fall.

Trainer Position

Trainer Stands behind the patient places one hand either on the right or left side of the pelvis, and let them to lean their whole body weight on to your hands. Require them to lean until the midline of the pelvis is over the right or left foot and then suddenly release your hold.

Repetition: 10 times per side.

Single Limb Stance

Subject stands with shoulder width apart and keeps their hands on their hips looks straight ahead and stands on one foot. Hold the lifted leg for 10 seconds and come to the starting position .Subjects can stand behind the chair for support or minimal assistance can be given with the examiner fingers tips.

Repetition: 10 times per leg.

Alternative Toe and Heel Standing

Subject stands with your shoulder width apart and if needed minimal assistance by resting their finger tips in examiner finger tips or stand behind the chair. They have to stand on their toes as high as possible and then stand on their heels. Maintain each position for five seconds

Repetition: 10 times.

Romberg Exercise

- Standing with feet together eyes open for 20 seconds and eyes closed for 20 seconds.
- Standing in tandem stance with eyes open for 20 seconds and eyes closed for 20 seconds.

Repetition: 10 times each exercise.

4.9. TREATMENT DURATION

1 hour per session for 3 times in a week for 4 weeks.

4.10. OUTCOME MEASURES

- Nutt Unexpected Retropulsive Test
- Tinetti Performance Oriented Mobility Scale
- 10 Meter Walk Test

4.11 STATISTICAL TOOLS

Pre-test and Post-test values of the study were collected and assessed for variation in improvement & their results were analyzed using Paired `t' test.

PAIRED `t' TEST (within groups)

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

Where,

$$S = \sqrt{\frac{\sum d^2 - \left[\bar{d}\right]^2 \times n}{n-1}}$$

S=combined standard deviation

$d_1 \& d_2$ =difference between initial & final readings in experimental group

$n_1 \& n_2$=number of patients in group A & group B respectively.

$\bar{X}_1 \& \bar{X}_2$ =Mean of group A & group B respectively.

Level of significance: 5%

5. DATA PRESENTATION AND ANALYSIS

5.1 TABULAR PRESENTATION

Table 5.1: paired‘t’ test value for tinetti performance oriented mobility assessment scale.

	Pre – test	Post – test
Mean ± SD	16.75	20.75
Mean difference	4	
Calculated ‘t’ value	4.419	
P value and level of significance	P < 0.05 and significant	

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 4.419. As the calculated value is greater than the table‘t’ value, the null hypothesis is rejected.

Table: 5.2: Paired‘t’ test value for Nutt Unexpected Retropulsive Test

	Pre – test	Post – test
Mean ± SD	1.875	0.75
Mean difference	1.125	
Calculated ‘t’ value	3.814	
P value and level of significance	P < 0.05 and significant	

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 3.814. As the calculated value is greater than the table‘t’ value, the null hypothesis is rejected.

Table: 5.3: Paired‘t’ test value for 10 Meter Walk Test at Comfortable Pace

	Pre – test	Post – test
Mean ± SD	21.31	23.75
Mean difference	2.44	
Calculated ‘t’ value	5.143	
P value and level of significance	P < 0.05 and significant	

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 5.143. As the calculated value is greater than the table‘t’ value, the null hypothesis is rejected.

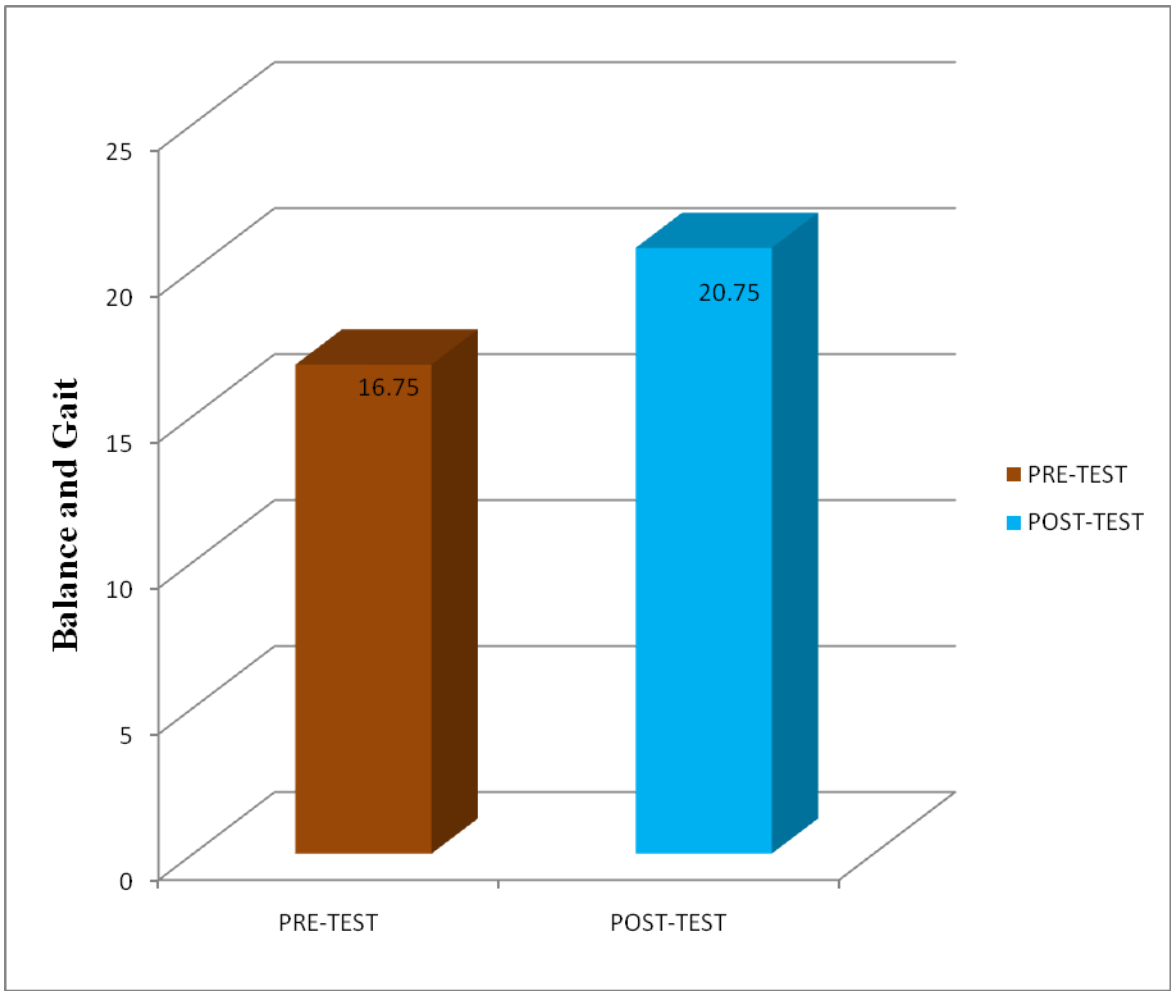
Table: 5.4: Paired‘t’ test value for 10 Meter Walk Test: Fast Pace

	Pre – test	Post – test
Mean ± SD	14.87	13.75
Mean difference	1.12	
Calculated ‘t’ value	0.234	
Table ‘t’ value	1.895	
P value and level of significance	P > 0.50 and not significant	

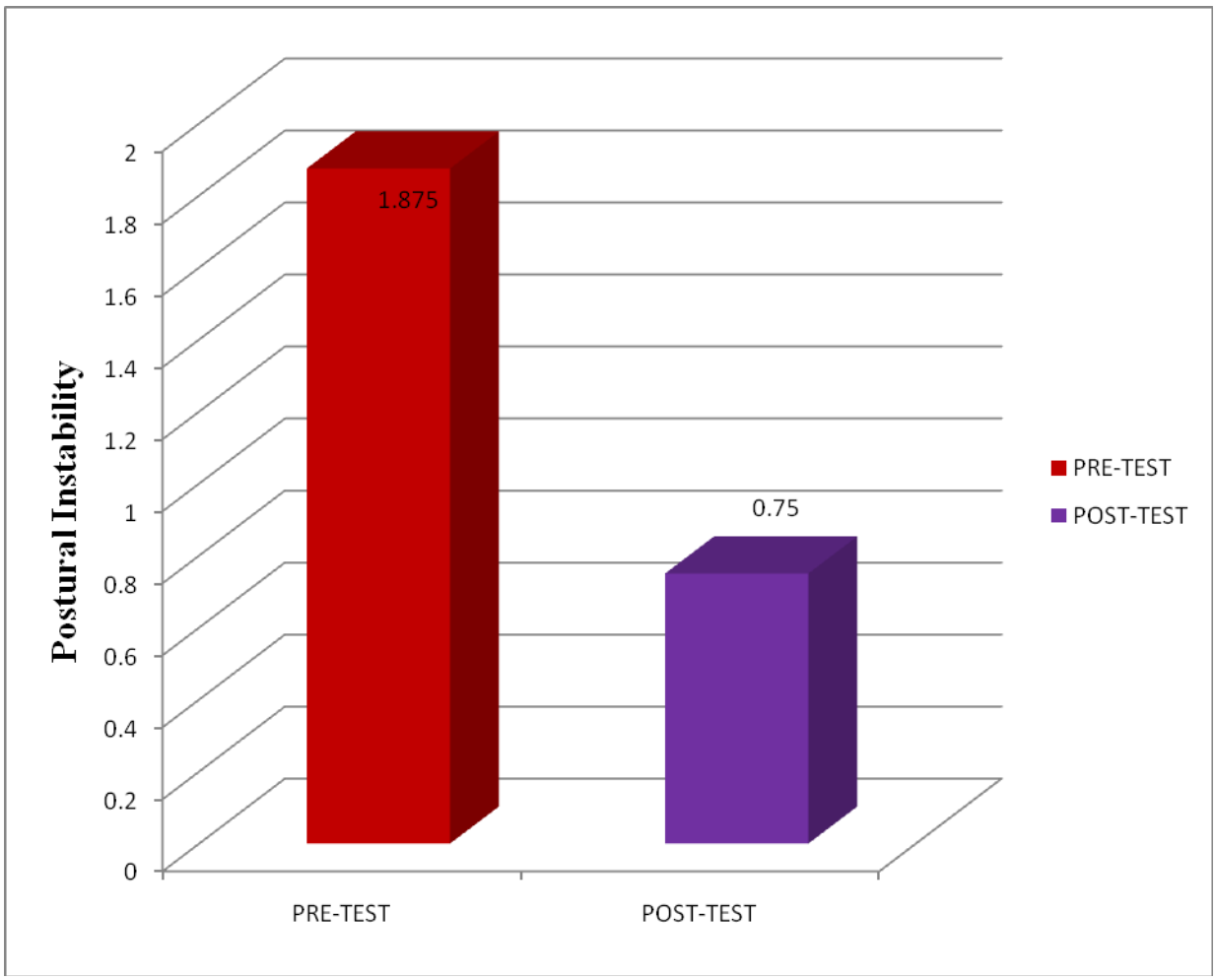
The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 0.234. As the calculated value is less than the table‘t’ value, the null hypothesis is accepted.

5.2. GRAPHICAL REPRESENTATION

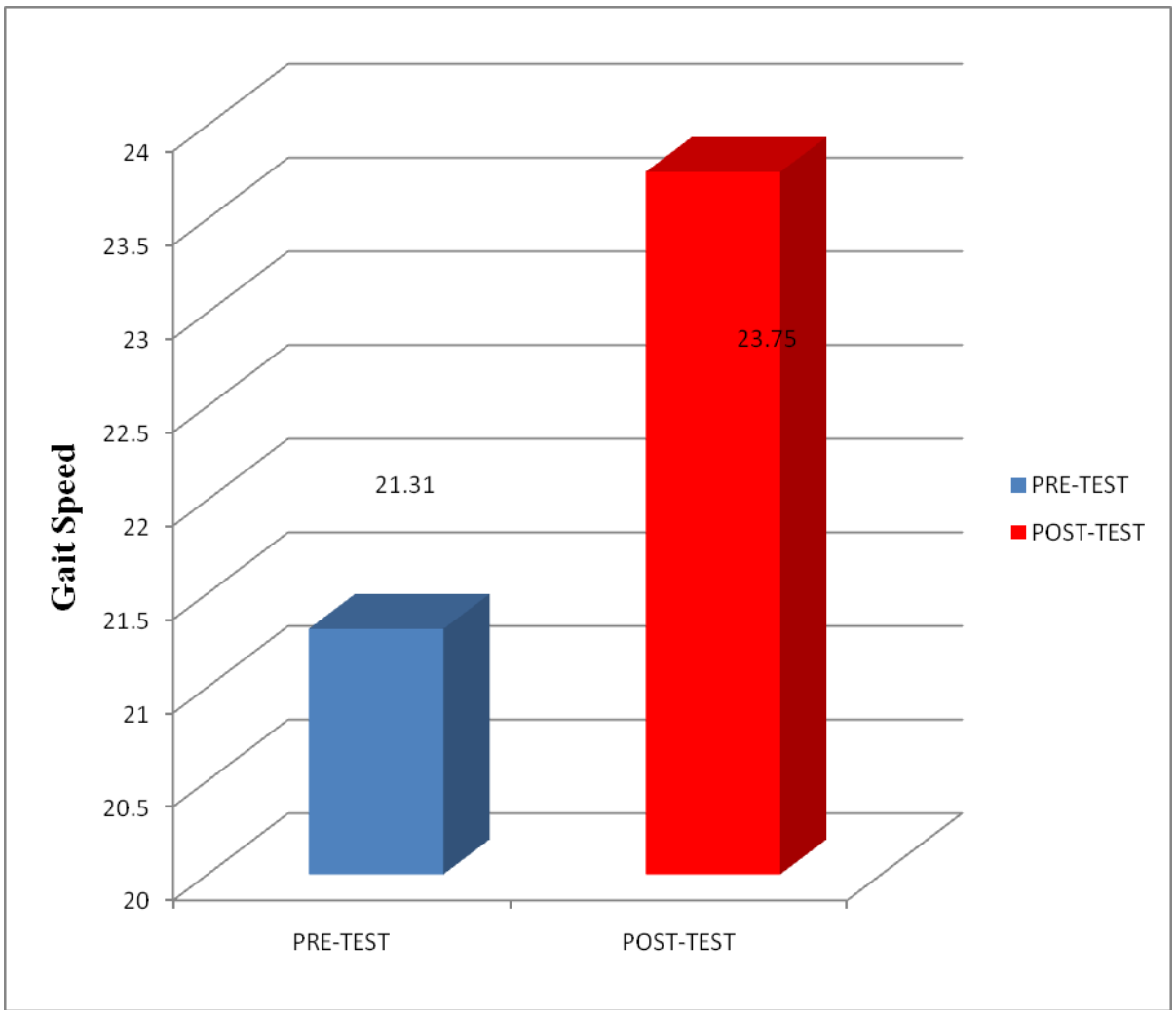
Graph: - 5.2.1: Graphical representation of pre-test and post-test mean value of Tinetti mobility scale.



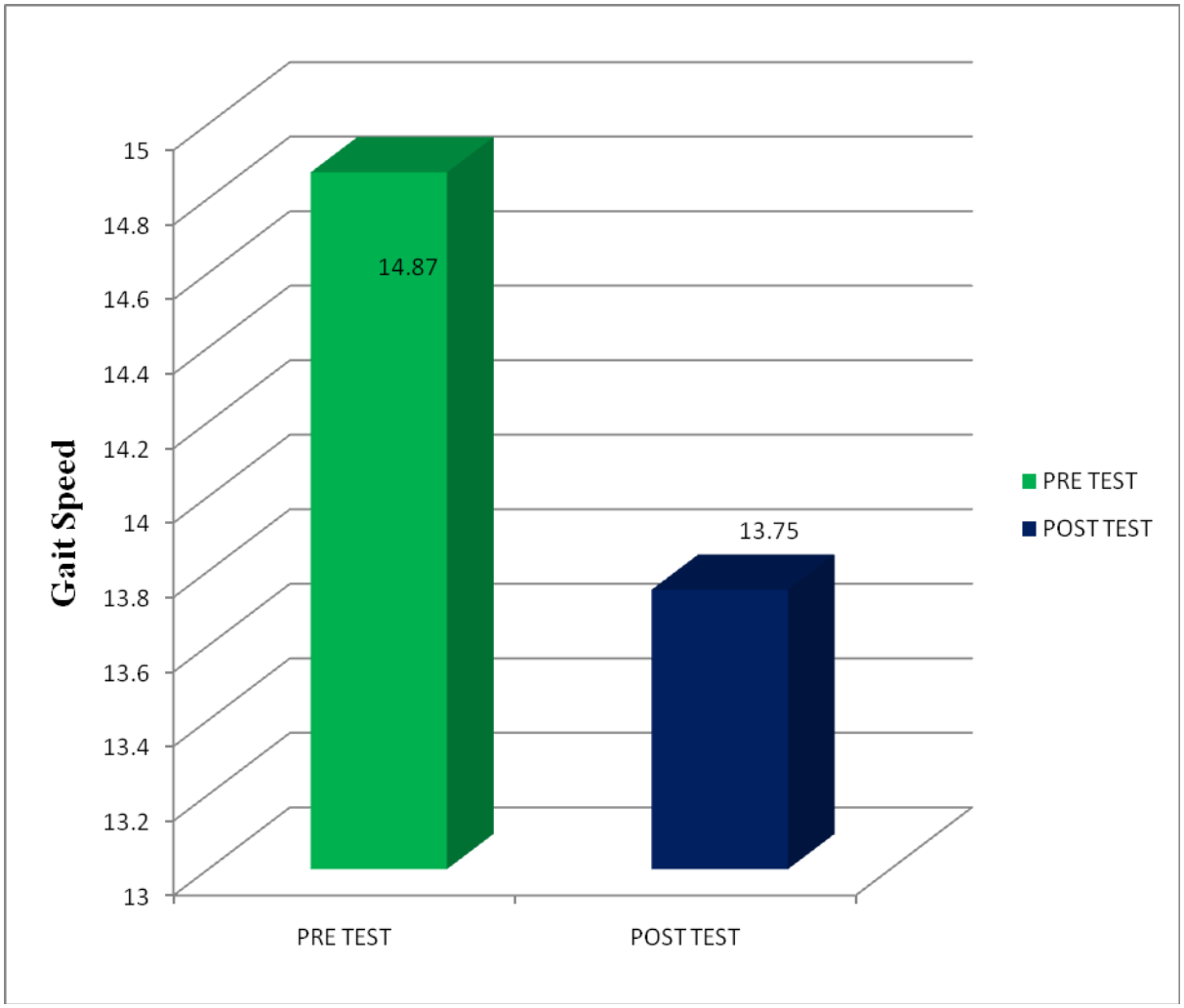
Graph:-5.2.2: Comparison of pre-test and post-test mean value of Nutt Unexpected Retropulsive Test.



Graph:-5.2.3: Comparison of pre-test and post-test mean value of 10 Meter Walk Test at Comfortable Pace.



Graph: 5.2.4: Comparison of pre-test and post-test mean value of 10 Meter Walk Test at fast Pace.



5.3 DATA ANALYSIS AND RESULT

The pre-test and post-test mean in all the three outcome measures are analyzed using Paired‘t’ test within the group.

TINETTI MOBILITY SCALE

The pre – test and post – test mean values of Tinetti Mobility scale in experimental group is analyzed by paired‘t’ test for postural instability. The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 4.419. As the calculated value is greater than the table‘t’ value, the null hypothesis is rejected. Hence there is a significant improvement in balance and gait components in idiopathic Parkinsonism patients.

NUTT UNEXPECTED RETROPULSIVE TEST

The pre – test and post – test values of Nutt Unexpected Retropulsive Test in experimental group is analyzed by paired‘t’ test for postural instability

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 3.814. As the calculated value is greater than the table‘t’ value, the null hypothesis is rejected. Hence there is a significant improvement in postural stability in idiopathic Parkinsonism patients.

10 METER WALK TEST: COMFORTABLE PACE

The pre – test and post – test values of 10 meter walk test at comfortable pace for the experimental group is analyzed by paired‘t’ test for gait speed.

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 5.143. As the calculated value is greater than the table‘t’ value .Hence the null hypothesis is rejected Hence there is a significant increase in gait speed in idiopathic Parkinsonism patients during their comfortable pace walking.

10 METER WALK TEST: FAST PACE

The pre – test and post – test values of 10 meter walk test at fast pace for the experimental group is analyzed by paired‘t’ test for gait speed.

The table‘t’ value at the level of 5 % significance and for 7 degrees of freedom is 1.895 and the calculated ‘t’ value is 0.234. As the calculated value is less than the table‘t’ value, the null hypothesis is accepted. Hence there is no significant change in gait speed in idiopathic Parkinsonism patients during the fast pace of gait.

6. DISCUSSION

Postural problem and gait disturbance is a common serious sign in idiopathic Parkinson patients, which are characterized as an impairment to maintain the upright position and therefore affects the gross motor and general mobility. Up to 96% percentage of all idiopathic Parkinson patients experience a decline of postural reactions during the course of the disease.

There are various exercise interventions available to improve the postural stability, balance and gait. Tai chi, yoga, tango, resistance exercise ,balance training, strength training, range of motion ,core training, treadmill walking with body weight support and aerobic programme which are commonly followed .

In the present study, eight patients are included, patients received Balance Retraining Strategy for a duration of 4 weeks .Nutt Unexpected Retropulsive Test is taken as a outcome measures for assessing postural instability, and balance and gait is assessed with Tinetti Performance Oriented Mobility Scale and gait speed is assessed with 10 Meter Walk Test. In this study we investigated the effects of newly formulated balance retraining strategy exercise protocol with proper dosage, duration, and intensity of the exercise.

Balance retraining strategy exercise included components like, forward in place response training, sit to stand training, single limb stance, backward perturbation training mainly focusing on the lower limb muscles and joints along with upper limb activities which provide much more demand on the posture maintenance. These exercises help to improve the muscle recruitment and increased the rate of recruitment along with increasing the force production and the rapidity of muscle contraction during the postural changes or whenever there is a change in the environment, thereby it helps to improve the postural control.

These exercises also help to improve the ability of the idiopathic Parkinson patients to switch between different co- ordination pattern during the gait and change in position. These exercises also help to act as a biofeedback to the participants of this study and which help to improve their response to similar situations.

There are observable changes seen in the temporal aspect of gait such as stance time and double limb support time and this leads to the improvement in balance. Patient response to the situation where a quick response is needed and the patient has to take a large step to quickly adjust the base of Support to maintain the balance, such as a change in the ground surfaces, or obstacle avoidance.

Increase in step length which is seen in the gait component of the Tinetti performance oriented mobility scale and this improvement has a positive effect on gait and postural stability. Combined forward and lateral leg lifting and stepping exercise help to improve the step length and foot clearance during the gait. There is an increased range of motion in hip, knee, ankle joint and it is observable during the gait.

These exercises also helps to improve the hip power generation during gait and also it help to improve the ankle range of motion and participants are using more of ankle strategy for maintaining their balance than the hip strategy. This has strong relation with improvement in postural stability balance and walking velocity. After this 4weeks of balance retraining strategy there is an improvement in muscle recruitment in the lower limb muscles compared to the pre test. And thereby improving the quality of life and reducing the fall risk in idiopathic Parkinson patients

7. SUMMARY AND CONCLUSION

The result of the study shows that the newly developed exercise protocol for the idiopathic Parkinson patients is safe, feasible exercise programme for rehabilitation. Balance Recovering Strategy plays an important role in improving postural stability and mobility in idiopathic Parkinson patients. This may be used as an adjunct treatment to physiotherapy to improve the physical performance and to enhance the gait stability.

8. LIMITATION AND SUGGESTION

- The samples studied were small so with larger scale randomized controlled studies should be compared with carefully designed control groups that receive similar amount of attention are recommended.

- The duration of treatment for 4 weeks might have been insufficient to promote an optimal response to intervention in our participants.

- The study was a short-term study and further studies can be done with long-term follow-up assessment to evaluate the long term improvement in balance and postural stability.

- The criterion for patient selection was much general. Further studies which compare the effect of balance retraining strategy in other stages of Modified Hoehn and Yahr should be conducted.

- Balance Retraining Strategy can be combined with other forms of physical therapy with Ideal delivery forms, dosage, frequency and intensity.

- In future further studies should be conducted to address whether treatment provides only symptomatic relief or whether it has any potential to modify the disease progression.

- The effect of balance retraining strategy on fall prevention in idiopathic Parkinson patients can be done in further studies.

- This technique can be applicable to older adults with similar age group with balance impairment.

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APPENDIX I

DATA PERFORMA

NAME :

AGE :

GENDER :

OCCUPATION :

ADDRESS :

DISEASE DURATION :

P D MEDICATION&DOSAGE :

GROUP :

DATE OF ASSESSMENT :

DATE OF END PROGRAMME :

HOEHN&YAHR STAGE :

MMSE SCORE :

U P D R S SCORE :

OUTCOME MEASURES	**PRE-TEST**	**POST-TEST**
T-POMA		
NUTT UNEXPECTED RETROPULTIVE TEST		
10-METER WALK TEST		

APPENDIX II

INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH STUDY

I _____ voluntarily consent to participate in the research study **"EFFECT OF BALANCE RETRAINING STRATEGY IN IMPROVING POSTURAL STABILITY AND GAIT SPEED AMONG IDIOPATHIC PARKINSON PATIENTS"**

The researcher has explained to me about the research in brief, the risk of participation and has answered the questions related to the research to my satisfaction

Signature of the subject: **Signature of the researcher:**

Signature of the witness:

APPENDIX III

SUBJECTS DETAILS

S.N	GENDER	AGE	HOEHN & YAHR STAGE	UPDRS			NUTT UNEXPECTED RETROPULSIVE TEST		TINETTI MOBILITY SCALE		TEN METER WALK TEST			
				MENTATION	ADL	MOTOR RESPONSE					COMFORTABLE PACE		FAST PACE	
							PRE	POST	PRE	POST	PRE	POST	PRE	POST
PD1	Male	62	2.5	2	14	32	2	1	16	22	28	30	17	16
PD2	Male	68	3	5	18	46	2	0	19	22	17	21.5	12	11
PD3	Male	60	2.5	5	13	24	2	0	18	20	16	19.5	10	10
PD4	Male	66	3	8	20	33	2	1	15	19	24	26.5	17	16
PD5	Male	72	3	5	15	47	2	1	16	24	30	32.5	23	20
PD6	Male	71	2.5	3	14	34	2	0	19	22	165.	16.5	10	9
PD7	Male	63	3	4	12	36	1	1	18	24	17	18.5	15	14
PD8	female	66	3	4	13	45	2	2	13	13	22	25	15	14

APPENDIX IV

UNIFIED PARKINSON'S DISEASE RATING SCALE

I. MENTATION, BEHAVIOR AND MOOD

1. Intellectual Impairment

0 = None.

1 = Mild. Consistent forgetfulness with partial recollection of events and no other difficulties.

2 = Moderate memory loss, with disorientation and moderate difficulty handling complex problems.Mild but definite impairment of function at home with need of occasional prompting.

3 = Severe memory loss with disorientation for time and often to place.
Severe impairment in handling problems.

4 = Severe memory loss with orientation preserved to person only. Unable to make judgements or solve problems. Requires much help with personal care. Cannot be left alone at all.

2. Thought Disorder (Due to dementia or drug intoxication)

0 = None.

1 = Vivid dreaming.

2 = "Benign" hallucinations with insight retained.

3 = Occasional to frequent hallucinations or delusions; without insight;
could interfere with daily activities.

4 = Persistent hallucinations, delusions, or florrid psychosis. Not able to care for self.

3. Depression

0 = None.

1 = Periods of sadness or guilt greater than normal, never sustained for days or weeks.

2 = Sustained depression (1 week or more).

3 = Sustained depression with vegetative symptoms (insomnia, anorexia, weight loss, loss of interest).

4 = Sustained depression with vegetative symptoms and suicidal thoughts or intent.

4. Motivation/Initiative

0 = Normal.

1 = Less assertive than usual; more passive.

2 = Loss of initiative or disinterest in elective (nonroutine) activities.

3 = Loss of initiative or disinterest in day to day (routine) activities.

4 = Withdrawn, complete loss of motivation.

II. ACTIVITIES OF DAILY LIVING *(for both "on" and "off")*

5. Speech

0 = Normal.

1 = Mildly affected. No difficulty being understood.

2 = Moderately affected. Sometimes asked to repeat statements.

3 = Severely affected. Frequently asked to repeat statements.

4 = Unintelligible most of the time.

6. Salivation

0 = Normal.

1 = Slight but definite excess of saliva in mouth; may have nighttime drooling.

2 = Moderately excessive saliva; may have minimal drooling.

3 = Marked excess of saliva with some drooling.

4 = Marked drooling, requires constant tissue or handkerchief.

7. Swallowing

0 = Normal.

1 = Rare choking.

2 = Occasional choking.

3 = Requires soft food.

4= Requires NG tube or gastrotomy feeding

8. Handwriting

0 = Normal.

1 = Slightly slow or small.

2 = Moderately slow or small; all words are legible.

3 = Severely affected; not all words are legible.

4 = The majority of words are not legible.

9. Cutting food and handling utensils

0 = Normal.

1 = Somewhat slow and clumsy, but no help needed.

2 = Can cut most foods, although clumsy and slow; some help needed.

3 = Food must be cut by someone, but can still feed slowly.

4 = Needs to be fed.

10. Dressing

0 = Normal.

1 = Somewhat slow, but no help needed.

2 = Occasional assistance with buttoning, getting arms in sleeves.

3 = Considerable help required, but can do some things alone.

4 = Helpless.

11. Hygiene

0 = Normal.

1 = Somewhat slow, but no help needed.

2 = Needs help to shower or bathe; or very slow in hygienic care.

3 = Requires assistance for washing, brushing teeth, combing hair, going to bathroom.

4 = Foley catheter or other mechanical aids.

12. Turning in bed and adjusting bed clothes

0 = Normal.

1 = Somewhat slow and clumsy, but no help needed.

2 = Can turn alone or adjust sheets, but with great difficulty.

3 = Can initiate, but not turn or adjust sheets alone.

4 = Helpless.

13. Falling (unrelated to freezing)

0 = None.

1 = Rare falling.

2 = Occasionally falls, less than once per day.

3 = Falls an average of once daily.

4 = Falls more than once daily.

14. Freezing when walking

0 = None.

1 = Rare freezing when walking; may have starthesitation.

2 = Occasional freezing when walking.

3 = Frequent freezing. Occasionally falls from freezing.

4 = Frequent falls from freezing.

15. Walking

0 = Normal.

1 = Mild difficulty. May not swing arms or may tend to drag leg.

2 = Moderate difficulty, but requires little or no assistance.

3 = Severe disturbance of walking, requiring assistance.

4 = Cannot walk at all, even with assistance.

16. Tremor (Symptomatic complaint of tremor in any part of body.)

0 = Absent.

1 = Slight and infrequently present.

2 = Moderate; bothersome to patient.

3 = Severe; interferes with many activities.

4 = Marked; interferes with most activities

17. Sensory complaints related to parkinsonism

0 = None.

1 = Occasionally has numbness, tingling, or mild aching.

2 = Frequently has numbness, tingling, or aching; not distressing.

3 = Frequent painful sensations.

4 = Excruciating pain.

III. MOTOR EXAMINATION

18. Speech

0 = Normal.

1 = Slight loss of expression, diction and/or volume.

2 = Monotone, slurred but understandable; moderately impaired.

3 = Marked impairment, difficult to understand.

4 = Unintelligible.

19. Facial Expression

0 = Normal.

1 = Minimal hypomimia, could be normal "Poker Face".

2 = Slight but definitely abnormal diminution of facial expression.

3 = Moderate hypomimia; lips parted some of the time.

4 = Masked or fixed facies with severe or complete loss of facial expression;

lips parted 1/4 inch or more

20. Tremor at rest (head, upper and lower extremities)

0 = Absent.

1 = Slight and infrequently present.

2 = Mild in amplitude and persistent. Or moderate in amplitude, but only intermittently present.

3 = Moderate in amplitude and present most of the time.

4 = Marked in amplitude and present most of the time.

21. Action or Postural Tremor of hands

0 = Absent.

1 = Slight; present with action.

2 = Moderate in amplitude, present with action.

3 = Moderate in amplitude with posture holding as well as action.

4 = Marked in amplitude; interferes with feeding.

22. Rigidity (Judged on passive movement of major joints with patient relaxed in sitting position. Cogwheeling to be ignored.)

0 = Absent.

1 = Slight or detectable only when activated by mirror or other movements.

2 = Mild to moderate.

3 = Marked, but full range of motion easily achieved.

4 = Severe, range of motion achieved with difficulty.

23. Finger Taps (Patient taps thumb with index finger in rapid succession.)

0 = Normal.

1 = Mild slowing and/or reduction in amplitude.

2 = Moderately impaired. Definite and early fatiguing. May have occasional arrests in movement.

3 = Severely impaired. Frequent hesitation in initiating movements or arrests in ongoing movement.

4 = Can barely perform the task.

24. Hand Movements (Patient opens and closes hands in rapid succesion.)

0 = Normal.

1 = Mild slowing and/or reduction in amplitude.

2 = Moderately impaired. Definite and early fatiguing. May have occasional arrests in movement.

3 = Severely impaired. Frequent hesitation in initiating movements or arrests in ongoing movement.

4 = Can barely perform the task.

25. Rapid Alternating Movements of Hands (Pronation-supination movements of hands, vertically and horizontally, with as large an amplitude as possible, both hands simultaneously.)

0 = Normal.

1 = Mild slowing and/or reduction in amplitude.

2 = Moderately impaired. Definite and early fatiguing. May have occasional arrests in movement.

3 = Severely impaired. Frequent hesitation in initiating movements or arrests in ongoing movement.

4 = Can barely perform the task.

26. Leg Agility (Patient taps heel on the ground in rapid succession picking up entire leg. Amplitude should be at least 3 inches.)

0 = Normal.

1 = Mild slowing and/or reduction in amplitude.

2 = Moderately impaired. Definite and early fatiguing. May have occasional arrests in movement.

3 = Severely impaired. Frequent hesitation in initiating movements or arrests in ongoing movement.

4 = Can barely perform the task.

27. Arising from Chair

(Patient attempts to rise from a straightbacked chair, with arms folded across chest.)

0 = Normal.

1 = Slow; or may need more than one attempt.

2 = Pushes self up from arms of seat.

3 = Tends to fall back and may have to try more than one time, but can get up without help.

4 = Unable to arise without help.

28. Posture

0 = Normal erect.

1 = Not quite erect, slightly stooped posture; could be normal for older person.

2 = Moderately stooped posture, definitely abnormal; can be slightly leaning to one side.

3 = Severely stooped posture with kyphosis; can be moderately leaning to one side.

4 = Marked flexion with extreme abnormality of posture

29. Gait

0 = Normal.

1 = Walks slowly, may shuffle with short steps, but no festination (hastening steps) or propulsion.

2 = Walks with difficulty, but requires little or no assistance; may have some festination, short steps, or propulsion.

3 = Severe disturbance of gait, requiring assistance.

4 = Cannot walk at all, even with assistance.

30. Postural Stability (Response to sudden, strong posterior displacement produced by pull on shoulders while patient erect with eyes open and feet slightly apart. Patient is prepared.)

0 = Normal.

1 = Retropulsion, but recovers unaided.

2 = Absence of postural response; would fall if not caught by examiner.

3 = Very unstable, tends to lose balance spontaneously.

4 = Unable to stand without assistance.

31. Body Bradykinesia and Hypokinesia (Combining slowness, hesitancy, decreased armswing, small amplitude, and poverty of movement in general.)

0 = None.

1 = Minimal slowness, giving movement a deliberate character; could be normal for some persons.Possibly reduced amplitude.

2 = Mild degree of slowness and poverty of movement which is definitely abnormal. Alternatively, some reduced amplitude.

3 = Moderate slowness, poverty or small amplitude of movement.

4 = Marked slowness, poverty or small amplitude of movement

APPENDIX V

MODIFIED HOEHN AND YAHR STAGING

STAGE 0 = No signs of disease.

STAGE 1 = Unilateral disease.

STAGE 1.5 = Unilateral plus axial involvement.

STAGE 2 = Bilateral disease, without impairment of balance.

STAGE 2.5 = Mild bilateral disease, with recovery on pull test.

STAGE 3 = Mild to moderate bilateral disease; some postural instability; physically independent.

STAGE 4 = Severe disability; still able to walk or stand unassisted.

STAGE 5 = Wheelchair bound or bedridden unless aided

APPENDIX VI

TINETTI ASSESSMENT TOOL: DESCRIPTION

Population:	Adult population, elderly patients
Description:	The Tinetti Assessment Tool is a simple, easily administered test that measures a patient's gait and balance. The test is scored on the patient's ability to perform specific tasks.
Mode of Administration:	The Tinetti Assessment Tool is a task performance exam.
Time to Complete:	10 to 15 minutes
Time to Score:	Time to score is included in time to complete
Scoring:	Scoring of the Tinetti Assessment Tool is done on a three point ordinal scale with a range of 0 to 2. A score of 0 represents the most impairment, while a 2 would represent independence of the patient. The individual scores are then combined to form three measures; an overall gait assessment score, an overall balance assessment score, and a gait and balance score.
Interpretation:	The maximum score for the gait component is 12 points. The maximum score for the balance component is 16 points. The maximum total score is 28 points. In general, patients who score below 19 are at a high risk for falls. Patients who score in the range of 19-24 indicate that the patient has a risk for falls.
Reliability:	Interrater reliability was measured in a study of 15 patients by having a physician and a nurse test the patients at the same time. Agreement was found on over 85% of the items and the items that differed never did so by more than 10%. These results indicate that the Tinetti Assessment Tool has good interrater reliability.
Validity:	Not reported
References:	Lewis C. Balance, Gait Test Proves Simple Yet useful. *P.T. Bulletin* 1993; 2/10:9 & 40. Tinetti ME. Performance-Oriented Assessment of Mobility Problems in Elderly Patients. *JAGS* 1986; 34:119-126.

TINETTI ASSESSMENT TOOL: BALANCE

Patient's Name: _____ **Date:** _____

Location: _____ **Rater:** _____

Initial Instructions: Subject is seated in a hard, armless chair. The following maneuvers are tested.

Task	Description of Balance	Possible	Score
1. Sitting Balance	Leans or slides in chair Steady, safe	= 0 = 1	
2. Arises	Unable without help Able, uses arms to help Able without using arms	= 0 = 1 = 2	
3. Attempts to arise	Unable without help Able, requires > 1 attempt Able to rise, 1 attempt	= 0 = 1 = 2	
4. Immediate standing balance (first 5 seconds)	Unsteady (swaggers, moves feet, trunk sway) Steady but uses walker or other support Steady without walker or other support	= 0 = 1 = 2	
5. Standing Balance	Unsteady Steady but wi de stance (medial heels > 4 inches apart) and uses cane or other support Narrow stance without support	= 0 = 1 = 2	
6. Nudged (subject at max position with feet as close together as possible, examiner pushes lightly on subject's sternum with palm of hand 3 times.	Begins to fall Staggers, grabs, catches self Steady	= 0 = 1 = 2	
7. Eyes closed (at maximum position #6)	Unsteady Steady	= 0 = 1	
8. Turning 360 degrees	Discontinuous steps Continuous steps Unsteady (grabs, swaggers) Steady	= 0 = 1 = 0 = 1	
9. Sitting Down	Unsafe (misjudged distance, falls into chair) Uses arms or not a smooth motion Safe, smooth motion	= 0 = 1 = 2	
Balance Score:			

TINETTI ASSESSMENT TOOL: GAIT

Patient's Name: _____ **Date:** _____

Location: _____

Rater: _____

Initial Instructions: Subject stands with examiner, walks down hallway or across the room, first at "usual" pace, then back at "rapid, but safe" pace (using usual walking aids).

Task	Description of Gait	Possible	Score
10. Initiation of gait (immediately after told to "go")	Any hesitancy or multiple attempts to start No hesitancy	= 0 = 1	
11. Step length and Height	a. Right swing foot does not pass left stance foot with step b. Right foot passes left stance foot c. Right foot does not clear floor completely with step d. Right foot completely clears floor e. Left swing foot does not pass right stance foot with step f. Left foot passes right stance foot g. Left foot does not clear floor completely with step h. Left foot completely clears floor	= 0 = 1 = 0 = 1 = 0 = 1 = 0 = 1	
12. Step Symmetry	Right and left step length not equal (estimate) Right and left step appear equal	= 0 = 1	
13. Step Continuity	Stopping or discontinuity between steps Steps appear continuous	= 0 = 1	
14. Path (estimated in relation to floor tiles, 12-inch diameter; observe excursion of 1 foot over about 10 feet of the course).	Marked deviation Mild/moderate deviation or uses walking aid Straight without walking aid	= 0 = 1 = 2	
15. Trunk	Marked sway or uses walking aid No sway but flexion of knees or back, or spreads arms out while walking No sway, no flexion, no use of arms, and no use of walking aid	= 0 = 1 = 2	
16. Walking Stance	Heels apart Heels almost touching while walking	= 0 = 1	
Gait Score:			
	Balance + Gait Score:		

APPENDIX VII

TEN METER WALK TEST

PROCEDURE

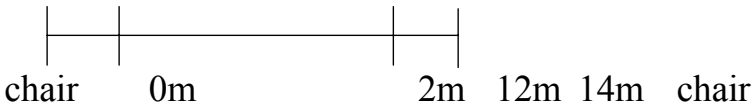
Description: The ten-meter walk test is a measure of walking speed.

Equipment: Form C1, digital stopwatch, measuring tape, masking tape, quiet hallway or open space at least 14 meters long

Note: The participant should be wearing flat shoes or shoes with a heel less than 1/2 inch. Otherwise, the participant should walk with well fit hospital slippers. Have the participant perform this test with their most often used assistive device and/or brace.

Administration:

1. A measured course indoors is established with a length of 14 meters. Lines are drawn with tape at 0 meters, 2 meters, 12 meters and 14 meters.



2. With the participant seated, measure the participant's resting heart rate and blood pressure. Refer to the Cardiovascular Activity Tolerance Guidelines if the blood pressure is greater than 180/110 mmHg or if heart rate is greater than 100 bpm or 80% predicted HR max (220-age).

3. Give the participant the following information: **"You are going to walk a distance of about 40 feet. We will repeat this distance four times. The first two times will be completed at your comfortable pace, the final two times you will walk as quickly and safely as you can. Do you have any questions?"**

4. Have the participant proceed to the start line (0 meters). Before the 1st trial, tell the participant **"you will walk at a comfortable pace to the chair *."** (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor.) **The start command will be 'Ready and Go'.**

5. When you and the participant are ready, say **"Ready and Go"**. If the participant starts too early, have them start again.

6. **START THE STOPWATCH** when the participant's first foot crosses the plane of the **2 meter line** and **STOP THE STOPWATCH** when the participant's first foot crosses the plane of the **12 meter line**. Have the participant continue walking until he/she reaches the chair after the 14 meter line.

7. Record (in seconds to the hundredths) the time it took for the participant to walk the ten- meter distance between the 2 meter line and the 12 meter line.

8. Have the participant rest, if needed, in the chair at the 14 meter line.

9. The participant is going to repeat the **EXACT SAME procedure** as described above for the 2nd trial at a "**comfortable pace**" - except the participant will be walking from the 14m line to the 0m line. START the stopwatch at the 12m line, and STOP the stopwatch at the 2m line.

10. Record the time (in seconds to the hundredths) for the 2nd trial at a "comfortable pace". The participant can rest, if needed, in the chair at the 0 meter line.

11. The participant is now instructed that for the last 2 trials, he/she is going to walk **"as quickly as he/she can."**

12. Have the participant proceed to the start line (0 meters). Instruct the participant to**"walk as quickly and safely as you can to the chair *"** (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor.). The command will be **"READY, AND, GO…"** and the participant will start when you say **"GO"**. If the participant starts too early, please stop and try again.

13. **START THE STOPWATCH** when the participant's first foot crosses the plane of the **2 meter line** and **STOP THE STOPWATCH** when the participant's first foot crosses the plane of the **12 meter line**. Have the participant continue walking until he/she reaches the chair, after the 14 meter line.

14. Record (in seconds to the hundredths) the time it took for the participant to walk the ten meters.

15. Have the participant rest, if needed, in the chair at the 14 meter line.

16. The participant is going to repeat the **EXACT SAME procedure** as described above for the 2nd trial. Instruct the participant to **"walk as quickly and safely as you can to the chair *"** (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor.) - Except the participant will be walking from the 14m line to the 0m line. START the stopwatch at the 12m line, and STOP the stopwatch at the 2m line.

17. Record the time (in seconds to the hundredths) for the 2nd trial. The participant can rest in the chair at the 0m line.

18. Immediately take the participant’s pulse and blood pressure when he/she is sitting in the chair.

19. Record assistive device, type of AFO (if appropriate) and FAC (categorization) on the C1 form

ITEM	Pre	Post	
Pre-test Heart Rate			
Pre-test Blood Pressure			

INSTRUCTIONS TO PATIENT

You are going to walk a distance of about 40 feet. We will repeat this distance four times. The first two times will be completed at your comfortable pace, the final two times you will walk as quickly and safely as you can. Do you have any questions?

"Comfortable" Pace Trial 1 (seconds)			You will walk at a comfortable pace to the chair *. (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor). The start command will be 'Ready and Go. Ready and Go.
"Comfortable" Pace Trial 2 (seconds)			Walk at a comfortable pace to the chair *. (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor). Ready and Go.
"As Fast as Possible" Pace Trial 1 (seconds)			Walk as quickly and safely as you can to the chair *" (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor.). Ready and Go.
"As Fast as Possible" Pace Trial 2 (seconds)			Walk as quickly and safely as you can to the chair *" (*Use appropriate descriptor of chair/location as needed but DO NOT refer to the tape on the floor.). Ready and Go.
Post-test Heart Rate			**Velocity** Pre-test Comfortable Pace _____m/s (avg 2 trials) As Fast as Possible Pace _____m/s (avg 2 trials) Post-test Comfortable Pace _____m/s (avg 2 trials) As Fast as Possible Pace _____m/s (avg 2 trials)
Post-test Blood Pressure			
Assistive Device Used			
Type of AFO			**Comments:**
Functional Ambulation Category 1. Non functional ambulator 2. Ambulator - Dependent for Physical Assistance Level II 3. Ambulator - Dependent for Physical Assistance level I 4. Ambulator - Dependent for Supervision 5. Independent, level surfaces only 6. Independent			

APPENDIX VIII

NUTT UNEXPECTED RETROPULSIVE TEST

When executed once, this test has a higher overall predictive accuracy when compared with the expected test (Visser e t al.,2003), and it yields the most accurate results for appropriate therapeutic intervention. If executed more than once, the element of surprise (or unexpectedness) is gone and the results will be less definitive (Visser e t al.,2003).Technically, the protocols for retropulsive tests are performed by pulling backward on the shoulders. Because of the wide variety of recovery abilities and for safety concerns, using a gait belt and pulling backward on the gait belt using the following method is recommended.

Technique

- The therapist stands behind the patients.
- The patient's feet are positioned comfortably apart and parallel (not one ahead of the other).
- Without warning, the therapist pulls the patient briskly backward using sufficient force to create a loss of balance that requires stepping response.

Common errors in the patient position

- Bracing forward
- Standing with an increased base of support.

Common errors in the therapist's position or execution are-

- Pulling continuously and steadily (which does not create the element of surprise needed or the velocity that would facilitate a stepping strategy sooner)
- Not pulling with sufficient force to elicit a stepping strategy.
- Standing too close to the patient, limiting the patient's space and ability to react (Munhoz et al, 2004).

Rating Scale

0=Normal; may take two steps to recover

1=takes three or more steps and recovers unaided.

2=would fall if not caught.

3=spontaneous tendency to fall or unable to stand unaided (test not executable).This scale indicates the patient's response to regain an unexpected loss of balance.